INFRARED CAMERA SURVEYS FIRE SCENE

Even after a forest fire subsides, firefighters remain alert for hot spots, areas where wood still smolders. These spots can ignite almost instantly if a gust of wind fans them, even slightly. Because they burn with little smoke and no flame, hot spots are difficult to locate.

The Jet Propulsion Laboratory (JPL; Pasadena, CA), in partnership with Amber, developed a highly sensitive, handheld camera that could help firefighters pinpoint hot spots after forest fires. The camera features quantum-well infrared photodetectors (QWIPs) that cover an essential long-wavelength portion of the infrared spectrum. This capability allows the camera to see through smoke and detect lingering hot spots that appear innocuous to the eye. It works effectively in both daytime and nighttime conditions.

Built on gallium arsenide (GaAs) substrates, QWIPs are tiny structures that are extremely sensitive to heat radiation. GaAs-based QWIPs are easier to manufacture than conventional mercury long-wavelength infrared detectors, which can have low yields and high costs. The QWIP cameras' cost should drop below that of competing infrared cameras as the technology matures.

In its debut as a fire-observing device, JPL's camera helped a news crew from KCAL-TV in Los Angeles cover the dramatic Malibu fires in October 1996. The camera hopped a flight on the station's news helicopter, allowing the crew and television audience to get a unique perspective on the fires. It enabled the station to transmit live images of the hot spots by detecting their infrared heat patterns.

Other potential applications of the technology range from the prosaic to the provocative. In the medical arena, by sensing a change in the heat pattern of the patient's blood, the camera could enable doctors to detect tumors close to a patient's skin. By providing a visual image of airport runways in bad weather conditions, it could help pilots to make more precise landings. Pollution monitoring, weather detection, law enforcement, and search-and-rescue operations may also benefit from JPL's technology.

NASA- and BMDO-sponsored programs funded JPL's QWIP research. NASA may use the technology for observation satellites, while BMDO will use it to study the phenomenology of missile plumes. In a recent proposal to BMDO, Amber has proposed to build and sell 15 QWIP-based infrared cameras to explore potential research opportunities. In addition, a QWIP-based camera is being considered for use on a second Clementine satellite mission.

ABOUT THE TECHNOLOGY

A quantum well is a microscopic "trap" for an electron inside a transparent solid medium. When exposed to radiation of the appropriate wavelength, the electron can be liberated, producing an electric current. Many quantum wells in a pixel can be used to detect infrared light with a total current proportional to the amount of light hitting the pixel.

The QWIP camera uses a 256 x 256 focal plane array tuned to detect infrared radiation in the 8- to 9-micron wavelength range. It contains a Stirling cooler, a closed-cycle refrigerator about the size of a fist. The small motor circulates a gas to cool the array from room temperature to very low temperatures, about –343˚F, in 10 minutes. The camera weighs just 10 pounds, and it measures about 4.5 inches wide, 10.5 inches deep, and 7 inches high. The camera's current prototype plugs into a 110-volt wall socket for power, although battery power can make it portable.

Can You Imagine . . .

. . . a highly sensitive, hand-held camera that could help firefighters pinpoint hot spots after forest fires.

JPL'S CAMERA HELPED A LOS ANGELES TELEVISION NEWS CREW GET A UNIQUE PERSPECTIVE ON FIRES THAT RACED THROUGH MALIBU, CALIFORNIA.

■ Pictured above is the first portable QWIP camera, which uses a 256 x 256 focal plane array tuned to detect infrared radiation in the 8- to 9-micron wavelength range.